/AVM

Senior International Vedic Maths Olympiad 2022
Time allowed - 1 Hour

Questions 1 - 25 each carry 2 marks

1. $5.0 - 0.5 + 0.05 - 0.005 + 0.0005$

   A 4.5555 **B** 4.4545 **C** 4.5454 **D** 4.4555 **E** 4.5455

2. Which of the following is **not** divisible by 9?

   A 277227722772 **B** 90817263542 **C** 432234432234 **D** 1234545678 **E** 623637613683

3. When using Vertically and crosswise to calculate 367×482, what is the result of the third step before any carry digits are included?

   A 72 **B** 78 **C** 80 **D** 82 **E** 92

4. Given that $3 \times 37 = 111$, calculate $999999 \div 37$.

   A 54054 **B** 45045 **C** 36036 **D** 18018 **E** 27027

5. What is the square root of 0.00005625?

   A 0.075 **B** 0.0075 **C** 0.00075 **D** 0.000075 **E** None of these

6. One of the following shows the correct working for 329×989 using Nikhilam multiplication. Which one?

   A
   $$329 - 6\ 7\ 1$$
   $$\times\ 989 - 0\ 0\ 1$$
   $$325 \,/\, _7 3 _7 8 _1 1$$

   B
   $$329 - 6\ 7\ 1$$
   $$\times\ 989 - 1\ 1\ 1$$
   $$325 \,/\, _7 3 _7 8 _1 1$$

   C
   $$329 - 6\ 7\ 1$$
   $$\times\ 989 - 0\ 1\ 1$$
   $$325 \,/\, _7 3 _7 8 _1 1$$

   D
   $$329 - 6\ 7\ 1$$
   $$\times\ 989 - 0\ 1\ 1$$
   $$325 \,/\, _6 3 _7 8 _1 1$$

   E
   $$329 - 6\ 7\ 0$$
   $$\times\ 989 - 0\ 1\ 1$$
   $$325 \,/\, _7 3 _7 8 _1 1$$

7. The devinculated form of $6\overline{2}$ is 58. What is the devinculated form of $300\overline{23}7\overline{48}$?

   A 29977662 **B** 20077662 **C** 20087652 **D** 29977652 **E** 29976652

8. What are the final four digits of 99999999987^2?

   A 0169 **B** 9169 **C** 9983 **D** 0113 **E** 0913

9. Using Nikhilam division for 24219 ÷ 897, some workings are shown below. What are the three missing digits for A, B and C?

$$897 \overline{\left) \begin{array}{l} 2\,4\,/\,2\,1\,9 \\ A\ \ B\ C \\ 6\,1\,8 \\ \hline 2\,7\,/\,0\,0\,0 \end{array} \right.}$$

A 328   **B** 283   **C** 206   **D** 308   **E** 204

10. Which fraction is the largest?

A $\dfrac{24}{2972}$ **B** $\dfrac{12}{1483}$ **C** $\dfrac{6}{745}$ **D** $\dfrac{3}{373}$ **E** $\dfrac{1}{124}$

11. Convert, the partially recurring decimal, $0.16\dot{3}$, to a fraction in lowest terms.

A $\dfrac{9}{55}$ **B** $\dfrac{17}{111}$ **C** $\dfrac{81}{495}$ **D** $\dfrac{147}{900}$ **E** $\dfrac{163}{990}$

12. 78^3

A 474552   **B** 551368   **C** 548552   **D** 474462   **E** 475552

13. What are the last five digits of the recurring pattern in the decimal equivalent of $\frac{1}{39}$?

A …$2634\dot{1}$ **B** …$1394\dot{1}$ **C** …$2734\dot{1}$ **D** …$2664\dot{1}$ **E** …$2564\dot{1}$

14. Find the integer remainder for 12345678 ÷ 89789

A 13585   **B** 24685   **C** 42785   **D** 44585   **E** 68285

15. Which of the following is both a square and a cube?

A 49^8 **B** 81^7 **C** 125^3 **D** 216^5 **E** 343^6

16. What is the Lowest Common Multiple (LCM) of 38808 and 1320?

A 64 680   **B** 194 040   **C** 582 120   **D** 1 552 320   **E** 2 134 440

17. $\sqrt{123454321}$

      A 1111111   **B** 111111   **C** 11111   **D** 1111   **E** 111

18. Which of the following can be expressed as the difference of two cubes and also the product of two consecutive integers?

      A 721   **B** 875   **C** 936   **D** 973   **E** 992

19. In how many ways can 96 be expressed as the difference of two square integers?

      A 0   **B** 1   **C** 2   **D** 3   **E** 4

20. Simplify,

$$(x+2y+1)^2 - (x-2y-1)^2$$

      A $8xy+4x$ **B** $x^2+8xy+8y$ **C** $4xy+8x$ **D** $5x^2+8y^2+2$ **E** $2x^2+4xy+8y^2$

21. What is the square root of, $x^4-6x^3+17x^2-24x+16$?

      A $x^2-4x+16$ B x^2+4x+4 C x^2-3x-4 D x^2-3x+4 E x^2+3x-4

22. Given that $3x^2+3x-5$ is a factor of $6x^4-9x^3-7x^2+43x-30$, which of the following is another factor?

      A $2x^2-6x+6$ **B** $2x^2-7x+6$ **C** $2x^2+7x+6$ **D** $2x^2+5x+6$ **E** $2x^2-5x+6$

23. What is the equation of the line which is perpendicular to $3x+2y=7$ and which passes through the point with coordinates, (4, 3)?

      A $3x+2y=18$ **B** $3x-2y=6$ **C** $2x-3y=-1$ **D** $2x+3y=29$ **E** $2x+3y=7$

24. What is the radius of the circle with equation,

$$x^2+y^2+4x-10y-167=0 ?$$

      A 13   **B** 14   **C** 15   **D** 17   **E** 18

25.

a, b and c are positive integers that satisfy, $5a + \dfrac{5}{b + \frac{1}{c}} = 19$. What is the value of c?

A 1 **B** 2 **C** 3 **D** 4 **E** 5

Questions 26 - 35 each carry 3 marks

26. What are the values of A and B, given that Y and Z are linear functions of x?

$$\frac{14x + 4}{2x^2 + 9x - 5} = \frac{A}{Y} + \frac{B}{Z}$$

A 2 & 6 **B** 3 & 7 **C** 4 & 8 **D** 5 & 8 **E** 6 & 10

27. A bee enters cell A in a honeycomb with the aim of reaching cell J. The bee cannot go back into any cell with an earlier letter label. For example, to reach cell D, the bee can travel through ABCD or ACD or ABD but not ACBD.
How many possible ways are there for it to reach cell J?
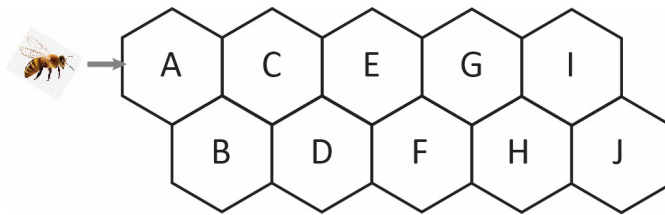
A 96 **B** 84 **C** 72 **D** 64 **E** 55

28. Two identical triangles overlap. The area of the overlapping region, B, is one sixth the area of the whole shaded region.
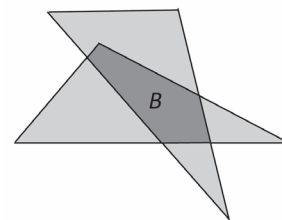
What fraction of the area of one triangle is the area B?

A $\dfrac{2}{5}$ **B** $\dfrac{1}{6}$ **C** $\dfrac{2}{7}$ **D** $\dfrac{3}{8}$ **E** $\dfrac{2}{9}$

29.

Given that $f(x) = \dfrac{x - 1}{3 - x}$, what is the inverse function, $f^{-1}(x)$?

A $\dfrac{1 - 3x}{x + 1}$ **B** $\dfrac{3x - 1}{x - 1}$ **C** $\dfrac{3x + 1}{x - 1}$ **D** $\dfrac{3x + 1}{x + 1}$ **E** $\dfrac{3x - 1}{x + 1}$

30. Simplify,

$$\left(1 + \frac{1}{x}\right)\left(1 - \frac{1}{x}\right)\left(\frac{1}{x+1} + \frac{1}{x-1}\right)$$

A $\dfrac{2}{x}$ **B** $\dfrac{2}{x^2}$ **C** $\dfrac{2}{x^2-1}$ **D** $\dfrac{2}{(x+1)(x-1)}$ **E** $\dfrac{2}{x^2(x+1)(x-1)}$

31. The equation, $x^2 - 98x + k = 0$, has two distinct solutions. What value must k be less than?

A 0   **B** 14   **C** 98   **D** 2401   **E** 9604

32. A parallelogram, *ABCD*, is drawn on a graph with vertices as shown. What is the numerical value of the area of the parallelogram?
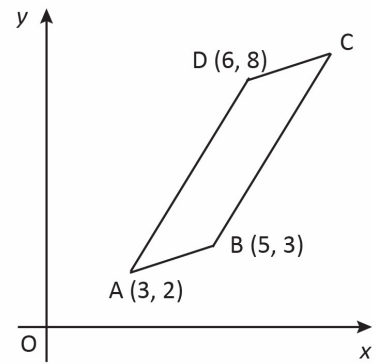
A 9   **B** 10   **C** 12   **D** 14   **E** 15

33. A triangle has base, $x - 7\,cm$, and height, $12 - 4x\,cm$, where *x* is a variable. What is its maximum area in cm^2 ?
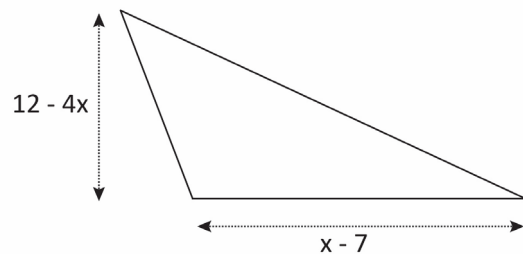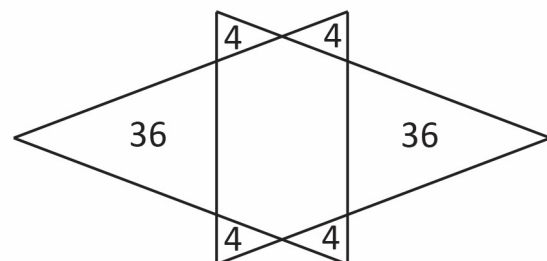
A 4   **B** 5   **C** 8   **D** 16   **E** 42

34. Two congruent isosceles triangles overlap producing a hexagon in the middle. The areas of the smaller triangles are 4 and the larger triangels, 36, as shown.
What is the area of the hexagon?

A 44   B 48   C 56   D 64   E 72

35. Angle Q is defined by the triple Q) 5 12 13.
What is the triple for the angle $\frac{1}{2}Q$?

A 3 4 5   **B** 3 2 $\sqrt{13}$ **C** 2 3 $\sqrt{13}$ **D** 13 5 $\sqrt{194}$ **E** $\sqrt{95}$ $\sqrt{5}$ $10\sqrt{5}$

Questions 36 - 40 each carry 4 marks

36. Given that $|x|<2$, what are the first three terms, in ascending powers of x, for the expansion of
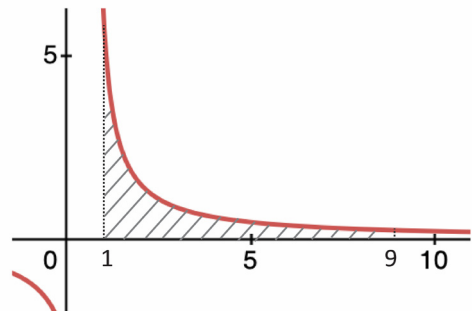
$$\frac{4}{(2+x)^2}?$$

A $1-4x+5x^2+\cdots$ **B** $1-x+\frac{3}{4}x^2+\cdots$ **C** $1+x-\frac{4}{5}x^2+\cdots$ **D** $1-x+\frac{5}{4}x^2+\cdots$ **E** $1+x+\frac{1}{4}x^2+\cdots$

37. What is the area under the curve given by

$$y=\frac{6}{3x-2}$$

between the lines, $x=1$ and $x=9$?

A $4ln5$ **B** $2ln24$ **C** $2ln3$

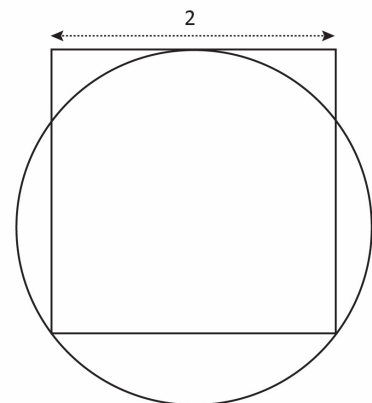**D** $2ln6$ **E** $6ln5$

38. What is the gradient of the curve with equation, $\dfrac{x^2}{3}+\dfrac{y^2}{4}=12$, at the point (-3, 6)?

A $\dfrac{2}{3}$ **B** $-\dfrac{2}{3}$ **C** $\dfrac{3}{2}$ **D** $-\dfrac{3}{2}$ **E** $\dfrac{4}{9}$

39. Two corners of a square, with side length 2, touch the circumference of a circle. One side of the square is tangent to the circle.

What is the circle's circumeference?
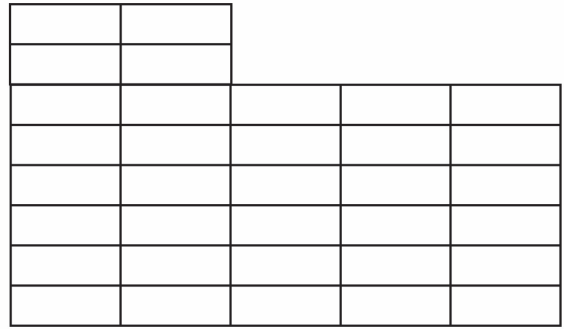
A $\sqrt{5}\pi$ **B** 2π **C** $2\sqrt{2}\pi$

D $\frac{4\sqrt{3}}{3}\pi$ **E** $\frac{5}{2}\pi$

40. How many rectangles of all types are there?

    A 34   **B** 56   **C** 300   **D** 324   **E** 360

Answer Key Senior IVMO 2022

1. E	11. A	21. D	31. D
2. B	12. A	22. E	32. A
3. D	13. E	23. C	33. C
4. E	14. D	24. B	34. C
5. B	15. E	25. D	35. B
6. C	16. B	26. A	36. B
7. D	17. C	27. E	37. A
8. A	18. E	28. C	38. A
9. C	19. E	29. D	39. E
10. B	20. A	30. A	40. E

Answer Key Junior IVMO 2022

1.	11.	21.	31.	41.
2.	12.	22.	32.	42.
3.	13.	23.	33.	43.
4.	14.	24.	34.	44.
5.	15.	25.	35.	45.
6.	16.	26.	36.	46.
7.	17.	27.	37.	47.
8.	18.	28.	38.	48.
9.	19.	29.	39.	49.
10.	20.	30.	40.	50.

Answer Sheet

1.		11.		21.		31.		41.	
2.		12.		22.		32.		42.	
3.		13.		23.		33.		43.	
4.		14.		24.		34.		44.	
5.		15.		25.		35.		45.	
6.		16.		26.		36.		46.	
7.		17.		27.		37.		47.	
8.		18.		28.		38.		48.	
9.		19.		29.		39.		49.	
10.		20.		30.		40.		50.	